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Geosocial Networking Application Use, Characteristics of App-Met Sexual Partners, and Sexual Behavior Among Sexual and Gender Minority Adolescents Assigned Male at Birth

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ABSTRACT

Although many sexual and gender minorities (SGM) assigned male at birth (AMAB) use sexual networking applications intended for adult sexual minority men, little is known about adolescents' use of these technologies and characteristics of their online-met partners. We conducted an online survey of 219 sexually experienced SGM AMAB adolescents in the USA aged 15–17 (39.3% racial/ethnic minority; 74.9% gay; 94.1% cisgender male). Questions assessed app use patterns, partner-seeking behaviors on sexual minority male-specific apps vs. social media/other dating apps, app-met partner characteristics, and sexual behavior with app-met partners. Most (70.3%) used apps for sexual minority men, 14.6% used social media/other apps to meet partners, and 15.1% used neither. Nearly 60% of adolescents who used any type of app reported having met people from the apps in person, and nearly 90% of these reported at least one online-met sexual partner. Most partners were reportedly older than participants, and participants were more likely to report condomless receptive anal sex with older (vs. younger) online-met partners. Although partnerships were primarily sexual in nature, a minority reported friendships or serious partnerships. Meeting same-sex/gender partners via applications for adults may be common among SGM AMAB adolescents, which has implications for their sexual health and well-being.

The introduction of geosocial networking (GSN) smartphone applications (“apps”) in the last decade has facilitated sexual partner seeking among sexual minority male adults in the U.S. (Goedel & Duncan, 2015; Paz-Bailey et al., 2017) and worldwide (Choi, Wong, & Fong, 2017; Krishnan et al., 2018; Lorimer, Flowers, Davis, & Frankis, 2016; Luo et al., 2019). These technologies allow users to explore sexual desires, meet sexual needs, and connect to the gay community (Holloway et al., 2014; Macapagal, Coventry, Puckett, Phillips, & Mustanski, 2016; Van De Wiele & Tong, 2014). GSN app use has been associated with greater engagement in sexual health services such as HIV testing among sexual minority men (Krishnan et al., 2018; Landovitz et al., 2013; Lorimer et al., 2016; Rendina, Jimenez, Grov, Ventuneac, & Parsons, 2014). However, GSN app use also has been tied to indicators of HIV/STI risk relative to general samples of sexual minority men (Landovitz et al., 2013), such as higher numbers of sex partners (Lehmiller & Ioege, 2014) and greater incidence of sexually transmitted infections (STIs; Beymer et al., 2014); though this is not uniformly the case, as some studies suggest app use may be linked with lower risk behavior (Luo et al., 2019).

Although GSN apps focused on sex and dating typically require users to be over age 18, these technologies also may appeal to sexual and gender minority minor adolescents (i.e., under age 18)

assigned male at birth (SGM AMAB; e.g., gay/bisexual adolescent boys, genderqueer youth AMAB). For adolescents who have not yet disclosed their sexual orientation identity or same-sex/gender attractions to others, or who may lack access to same-sex/gender partners where they live, GSN applications can provide a convenient, discreet way to find partners who themselves identify as sexual minorities (DuBois et al., 2015; Harper, Serrano, Bruce, & Bauermeister, 2016). As with adults, these applications have the potential to foster SGM AMAB's psychosocial well-being by helping them explore or confirm their sexual identity or reduce feelings of isolation. However, the sexual context of GSN applications may facilitate greater sexual risk taking among SGM AMAB who use them by expanding access to sexual partners and increasing the likelihood of (possibly risky) sex and/or by providing easy access to partners for those already more likely to engage in risk behavior (Jenness et al., 2010; Liao, Millett, & Marks, 2006).

To date, the only study of GSN application use among SGM AMAB under 18 found that over half of participants had used GSN applications intended for sexual minority men to meet male partners (Macapagal et al., 2018). Motivating their use was a lack of access to same-sex/gender partners and the desire to avoid unwanted disclosure or discovery of their sexual orientation. Of those who used apps, the vast majority had engaged in some sexual behavior with a partner initially

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met online. In addition, adolescents who ever used GSN applications for sexual minority men differed from those who used other types of sites or applications (e.g., social media, dating websites not exclusive to SGM individuals) to meet partners in their demographic characteristics, sexual risk, and sexual health behaviors. Compared to users of other applications, those who used apps for sexual minority men were older, had more lifetime sex partners, were more likely to have had sex exclusively with male partners, perceived themselves to be at greater risk of HIV, and reported greater rates of condomless anal sex. They were also somewhat more likely to have been tested for HIV compared to users of other types of apps (Macapagal et al., 2018).

As the aforementioned study was the first step in examining SGM AMAB's use of GSN applications for sexual minority men, other important questions remain, such as how many partners SGM AMAB meet through these online venues versus other venues, the characteristics of these sexual partners, and the nature of the relationships adolescents have with these partners. As most GSN application users are likely adults over age 18, adolescents' app-met partners may be older, which could pose legal risks if SGM AMAB are under the legal age for consensual sexual activity where they live. Age-discrepant sexual relationships also may pose sexual health risks for younger or relatively inexperienced sexual minority male youth (Anema et al., 2013). Compared to their heterosexual peers, sexual minority male youth's first sexual experiences are more likely to have been with partners over 5 years older (Glick et al., 2012). Although age-discrepant partnerships may have benefits for the younger partner (e.g., increased connectedness to gay community, perceived stability), they also may be associated with lower levels of control over condom use (Arrington-Sanders, Leonard, Brooks, Celentano, & Ellen, 2013) and increased substance use prior to sex (Arrington-Sanders et al., 2013; Bruce, Harper, Fernandez, & Jamil, 2012) which contribute to sexual risk-taking. Yet it is also plausible based on prior research on sexual minority men that adolescents are forming nonsexual relationships with people from the applications, such as friendships (Goedel & Duncan, 2015; Holloway et al., 2014). Moreover, as prior work observed differences in demographics and sexual behaviors between adolescents who had ever used apps for sexual minority men and those who had not, app use patterns, partner seeking, and characteristics of app-met partners may also vary between groups.

As SGM AMAB account for 73% of HIV diagnoses among U.S. adolescents 13–19 and 92% of diagnoses among male teenagers (Ocfemia, Dunville, Zhang, Barrios, & Oster, 2018), research is urgently needed to shed light on contextual factors that may be linked with higher rates of HIV risk behavior. In addition, as it becomes more commonplace for adults to meet potential sex and romantic partners via apps, dating sites, and social media, research on online sexual behaviors among adolescents suggests that it is likely becoming more prevalent among this age group as well (Korchmaros, Ybarra, & Mitchell, 2015). Thus, understanding SGM AMAB adolescents' experiences with partner seeking in different online venues can advance our knowledge of the role modern communication technologies play in adolescent sexual development. This study sought to improve our understanding of SGM AMAB's patterns of GSN

app use, the characteristics of their app-met partners, and their relationships and sexual encounters with such partners. We explored demographic, sexual behavior, and app use differences between minor adolescent users of apps for sexual minority men, those who used other types of online spaces to meet partners (e.g., social media and dating apps/websites not specific to sexual minority men), and those who used neither. We also examined differences between those who did and did not have in-person meetings with app-met partners.

Method

From February to April 2018, we recruited participants for a study on GSN application use and sexual health in SGM adolescents. Participants were recruited from social media and research participant registries. Paid social media advertisements on Facebook and Instagram were delivered to adolescents aged 15–18 who listed interests relevant to SGM youth (e.g., pop culture figures, SGM-related organizations); the research team also shared study information on their Twitter accounts. Those recruited from registries received a one-time e-mail from the research team that included a description of the new study and a URL to the eligibility screener. Clicking on the advertisement or on the URL in the recruitment e-mail directed the individual to an online eligibility survey. Eligible individuals were AMAB; identified as a sexual minority (i.e., gay, bisexual, queer, questioning/unsure) and/or endorsed attraction to male partners; reported having had sexual contact with a partner of any gender; lived in the U.S.; and could read and write in English. The full sample consisted of 302 15–18-year olds; for this study, we restricted the analytic sample to the 219 participants under age 18 who answered a subset of survey questions about app use, sexual behavior, and partner characteristics described below.

Eligible individuals were e-mailed the URL to the study, and after clicking on the URL, participants reviewed an online consent form and, upon agreeing to participate, were routed to the 45–60-min survey. Participants who completed the survey and whose data passed the study's validation protocol (Grey et al., 2015) received a \$30 USD electronic gift card. Procedures were approved by the university's Institutional Review Board with a waiver of parental permission for minor adolescent participants. Given the study topic, we anticipated that participants might disclose information subject to mandated reporting requirements (e.g., sexual victimization of a minor by a legal adult) when answering questions with open-ended response formats. As such, the study team monitored the content of the open-ended responses throughout data collection. However, no responses triggered mandated reporting.

Measures

Sociodemographic Characteristics

In the screener, participants completed closed-ended items assessing age, race and ethnicity, birth-assigned sex, gender identity (woman, man, trans woman, trans man, genderqueer, gender nonconforming), and where they learned about the study (Facebook, Instagram, Twitter, other). In the main

survey, participants were asked closed-ended items about sexual orientation (asexual, bisexual, gay, pansexual, queer, questioning or unsure, mostly straight, heterosexual/straight), sexual orientation disclosure (i.e., “outness”) to parents (not out to any parents, out to at least one but not all, out to all of them) and relationship status (single, casual relationship, serious relationship). Items related to sexual orientation, gender identity, race, and recruitment source offered a write-in option for other responses. Geographic region was derived from participants’ home addresses, which were collected upon study completion. Several variables were dichotomized for analysis: race/ethnicity (non-Hispanic White vs. racial/ethnic minority), sexual orientation (gay vs. non-monosexual [bisexual, pansexual, queer, mostly straight, questioning]), and outness (out vs. not out).

Sexual Health, HIV Risk, and Substance Use

Participants were asked to select whether they had sex with “only guys”, “mostly guys but some girls”, “guys and girls equally”, “mostly girls but some guys”, or “only girls.” Then, they reported their number of partners of different genders and number of lifetime condomless receptive (CRAS) and insertive anal sex (CIAS) partners who were AMAB. Participants also reported their age at first consensual sex, with the behaviors constituting “sex” self-defined by participants. Two questions asked about their perceived likelihood of becoming infected with HIV (1 = extremely unlikely, 5 = extremely likely) as well as how frequently they worried about getting infected with HIV (1 = none of the time, 5 = all of the time; Napper, Fisher, & Reynolds, 2012); the mean of these two items was used for analyses. Participants were also asked if they had ever been tested for HIV and their status if known.

Regarding alcohol use, participants were asked about frequency, number of drinks on a typical day, and binge drinking in the past year (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001). Items were summed, with scores ranging from 0 (low alcohol use) to 12 (greater alcohol use). Participants also were asked to select whether they had ever used 11 types of recreational drugs (e.g., marijuana, hallucinogens, club drugs, opiates, cocaine) from a list (Centers for Disease Control and Prevention, 2014). Investigator-created items assessing lifetime frequency of using alcohol, marijuana, and all other substances before sex were given only to those who endorsed using those substances in the previous questions (“How frequently did you [drink alcohol/use marijuana/use other drugs] 1–2 h before having sex with your partners?”) and were scored on a 5-point scale (1 = never, 5 = always).

GSN Application Use and Meeting People Offline

Two items in the screener asked whether participants had ever used a GSN application for gay, bisexual, and queer (GBQ) guys who like guys, and whether they had ever used other types of GSN applications (e.g., Tinder) or social media (e.g., Facebook) that were not specific to sexual minority men to meet same-sex/gender partners (yes, no). Based on these items and following prior work (Macapagal et al., 2018), participants were classified into three groups for analysis. “GBQ-app users” were those who had reported ever using a GSN application for GBQ men to meet partners; “other-app users” were those who had never used GBQ apps but had used social

media or other dating apps not specific to sexual minority men to meet partners; and “non-users” were those who had used neither GBQ-apps nor other types of apps to meet partners.

GBQ-app users and other-app users completed a series of investigator created, closed- and open-ended items assessing patterns of app use and experiences meeting men from apps offline. These questions were positioned in the middle of the survey, after an introductory section on demographics, sexual behavior, and health risk behaviors, and before a section on sex education preferences, sexually explicit media, and mental health, among other topics (data from these latter surveys not reported here). All participants were asked an open-ended question regarding where they had first heard of GBQ-specific apps. Several questions were asked only of current GBQ-app users, including age at first GBQ-app use and frequency of checking GBQ-apps, and three open-ended items assessing what GBQ-apps they had ever used to look for male partners, what apps were currently on their phone, and what apps they had stopped using. These latter three items were combined and recoded into one variable reflecting which apps they had ever used. Finally, questions specific to online partner-seeking were tailored for each participant group: “Have you ever had an in-person meeting with another [GBQ app user/guy from social media app or dating website] that you didn’t already know in person?” “In the past year, how many guys from [GBQ apps or websites/social media apps or dating websites] have you met in-person?” These items did not specify that the in-person meeting was for a sexual encounter, as participants may have had other reasons for meeting a GBQ app user face to face.

Sex and Relationships with App-Met Partners

Following those questions, participants were asked, “Have you ever had sexual contact that you wanted to have with a male partner you met through [an app for guys who like guys/social media or dating apps]?” “What types of sexual contact have you had with male partners you met through [apps for guys who like guys/social media or dating apps]?”

Participants who endorsed meeting at least one partner online were given a modified version of the *HIV Risk Assessment for Sexual Partnerships* (H-RASP; Mustanski, Starks, & Newcomb, 2014) which assessed characteristics and contexts of up to three of their most recent partnerships with individuals initially met online. Characteristics assessed included partner age (response options: older, younger, or about the same age), gender, race/ethnicity, HIV status and how they learned the partner’s status, whether the participant and the partner were on pre-exposure prophylaxis (PrEP) during their sexual relationship, the nature of the primary relationship they had with that partner, and any other types of relationships they had with that partner. Sexual behavior was assessed for each partner (types of sexual contact, number of times had insertive and receptive anal sex, and number of times they had CRAS and CIAS; the latter four were dichotomized into 0 vs. 1+ times). At the end of the survey, participants rated their comfort with answering questions about using GBQ apps and social media to meet partners (1 = very uncomfortable; 5 = very comfortable).

Data Analysis

Data were analyzed using SPSS 25. Descriptive statistics were computed for all variables, and medians and interquartile ranges are reported for skewed variables (where $SD > \text{mean}$). We assessed differences in demographics, sexual behavior, HIV risk factors including substance and alcohol use, app use behaviors, and app-met partner characteristics by app-use group at the bivariate level using one-way ANOVA and nonparametric tests for categorical (Pearson's χ^2) or skewed variables (Mann-Whitney tests for comparisons between two groups and Kruskal-Wallis tests for comparisons between three groups). For Kruskal-Wallis tests, results are presented in terms of each group's mean rank, rather than means of raw values. We similarly assessed group differences between those who had met partners from apps and those who had not, and whether certain app-met partner characteristics previously associated with sexual risk behavior (older vs. same age or younger than participant, race/ethnicity concordance vs. discordance, serious vs. not serious partnership) were associated with ever having had condomless anal sex (CAS) with app-met partners.

Results

Participants' sociodemographic characteristics, sexual behavior, and HIV risk factors are presented in Table 1. Participants ranged in age from 15 to 17 years old ($M \text{ age} = 16.3$; $SD = .74$ years, median = 17) and 39.3% identified as a racial/ethnic minority. Most participants identified as male (94.1%), gay (74.9%), and cisgender (94.1%), and were out to at least one parent (71.7%). Most had only ever had sex with male partners (79.9%). Mean age at first consensual sex was 14.78 years ($SD = 1.48$, median = 15, range 10–17). Of the 165 participants who had ever had anal sex with a male partner, 76.4% had had CAS (66.1% CRAS; 50.3% CIAS). Most participants were single (77.6%). Twenty-three percent of participants reported ever having an HIV test.

Regarding substance and alcohol use, participants' sum scores on the alcohol use items suggested relatively low use (median = 1, $IQR = 2$); most reported never drinking alcohol (46.6%) or drinking monthly or less (42.5%). Under half (44.7%) reported ever using marijuana, distantly trailed by hallucinogens (7.8%); all other substances were reported by less than 5% of participants. Finally, 11.5% of participants ever drank alcohol before sex, 32.7% of the $n = 98$ who reported using marijuana ever used it before sex, and 23.1% of the $n = 39$ who endorsed using any other drug reported using other drugs before sex.

Participants lived in 43 states reflecting all four geographic regions of the United States (South 33.3%, West 21.9%, Northeast 13.2%, Midwest 31.5%; Centers for Disease Control and Prevention [CDC], 2017). Nearly all participants learned about the study through Facebook (58.0%) and Instagram (39.7%), with the remaining 2.3% of participants describing Twitter, participant registries, or word of mouth. Of the participants who reached the end of the survey ($n = 180$), the majority (89.0%) reported feeling neutral to very comfortable answering the questions about app use.

Patterns of App Use and Group Differences

Most participants reported that they had used GSN apps for sexual minority men before ("GBQ-app users", 70.3%; $n = 154$), with fewer participants who had used other social media/dating applications but not GBQ apps ("other-app users", e.g., Tinder, Facebook; 14.6%; $n = 32$), or had used neither type of application to look for partners ("non-app users", 15.1%; $n = 33$). Those who had ever used GBQ apps reported an average age of 14.9 years ($SD = 1.29$ years, median = 15, range 10–17) at first use. Of the 112 GBQ-app users who disclosed the applications they had ever used, 66.1% reported Grindr only, and 27.7% reported having used multiple GBQ apps (typically Grindr plus one or more other apps, most frequently Scruff and Hornet). The remaining 6.2% reported only one of the several other GBQ-apps (e.g., Growlr, BRO; each mentioned by 1–2% of participants). Those who currently had apps on their phone reported checking the apps a median of 21 times a week ($IQR = 30$), and most frequently at night between 8 pm -midnight (median = 6 times, $IQR = 7$) relative to other times of day.

When asked in an open-ended item to list the sources where they had first heard of GBQ-specific apps, most reported that they had heard of them online (e.g., social media, advertising, online searches; 53.4%, $n = 117$). This was followed by friends (33.3%, $n = 73$), traditional media (e.g., TV, movies, newspapers, magazines; 14.6%, $n = 32$), and the App Store or Google Play (8.2%, $n = 18$). Others reported that it was "common knowledge" (7.7%, $n = 17$) and easily accessible in popular or queer culture (3.7%, $n = 8$).

When comparing the GBQ-app users, other-app users, and non-users on sociodemographic factors, a higher percentage of GBQ-app users (77.1%) and other-app users (75.0%) were out to their parents compared to non-users (45.5%), $\chi^2 (2, N = 218) = 13.676, p = .001$. Regarding sexual behavior and risk, there was a significant group difference in lifetime sexual partners, Kruskal-Wallis $H = 31.880, p < .001$, with a mean rank of 125.36 for GBQ-app users, 76.28 for other-app users, and 71.03 for non-users. There was also a significant difference in lifetime partners assigned male at birth, Kruskal-Wallis $H = 29.976, p < .001$, with a mean rank of 124.73 for GBQ-app users, 79.66 for other-app users, and 70.67 for non-users. Lifetime CIAS and CRAS partners did not significantly differ between groups.

Perceived risk of HIV also differed between groups, $F (2,216) = 4.816, p = .009$. Post-hoc tests showed that non-users reported lower perceived risk ($M = 1.84, SD = .82$) than GBQ-app users ($M = 2.34, SD = .88; p = .004$) and other-app users ($M = 2.44, SD = .93; p = .007$). Finally, a higher percentage of GBQ-app users had been tested for HIV (30.8%) relative to other-app users (13.3%) and non-users (6.7%), $\chi^2 (2, N = 203) = 10.180, p = .006$. The three groups did not differ on any other demographic, sexual risk, or substance and alcohol use variables.

Meeting Partners Online and in Person

Of the 186 participants whoever reported using GBQ-apps and other-apps, 58.6% ($n = 109$; 87 GBQ-app users, 22

Table 1. Descriptive statistics ($N = 219$).¹

	<i>n</i>	%
Age ($M = 16.38$, $SD = 0.74$)		
15	34	15.5
16	68	31.1
17	117	53.4
Race/ethnicity		
Asian	9	4.1
Black	14	6.4
Hispanic/Latino/x	30	13.7
Multiracial/other	33	15.1
White (non-Hispanic/Latino/x)	133	60.7
Sexual orientation		
Bisexual	37	16.9
Gay	164	74.9
Mostly straight	1	.5
Pansexual	8	3.7
Queer	4	1.8
Questioning/unsure	5	2.3
Gender identity		
Gender nonconforming	8	3.7
Genderqueer	5	2.3
Man	206	94.1
Outness to parents/guardians		
Not out to parents	61	27.9
Out to one parent, but not all	35	16.0
Out to all parents	122	55.7
I do not want to answer	1	.5
Geographic region		
South	73	33.3
Midwest	69	31.5
West	48	21.9
Northeast	29	13.2
Relationship status		
Single	170	77.6
In a casual relationship	24	11.0
In a serious relationship	25	11.4
Gender of sexual partners		
Only guys	175	79.9
Mostly guys but some girls	29	13.2
Guys and girls equally	8	3.7
Mostly girls but some guys	4	1.8
Only girls	3	1.4
Lifetime HIV testing		
No	153	69.9
Yes	50	22.8
I don't know	15	6.8
I don't want to answer	1	.5
HIV status ($n = 50$)		
Negative	49	98.0
I don't know	1	2.0
Comfort answering app use questions ($n = 180$)		
Very comfortable	68	37.8
Somewhat comfortable	48	26.7
Neither uncomfortable nor uncomfortable	44	24.4
Somewhat uncomfortable	15	8.3
Very uncomfortable	4	2.2
I do not want to answer	1	0.6
Frequency of alcohol use in past year		
Never	102	46.6
Monthly or less	93	42.5
2–4 times a month	19	8.7
2–3 times a week	4	1.8
I do not want to answer	1	0.5
Number of alcoholic drinks on a typical day ($n = 117$)		
1 or 2	62	53.0
3 or 4	27	23.1
5 or 6	19	16.2
7 or 9	5	4.3
10 or more	2	1.7
I do not want to answer	2	1.7
Frequency of 6+ drinks on one occasion ($n = 116$)		
Never	65	56.0
Less than monthly	41	35.3
Monthly	8	6.9
Weekly	2	1.7
Ever used recreational drugs		
Marijuana	98	44.7
Synthetic marijuana	6	2.7
Cocaine/crack	7	3.2

(Continued)

Table 1. (Continued).

	<i>n</i>	%
Opiates/heroin	1	.5
Methamphetamines	1	.5
GHB	2	.9
Ketamine	2	.9
Poppers	10	4.6
Other inhalants	7	3.2
Hallucinogens	17	7.8
Ecstasy	5	2.3
M		SD
HIV risk factors		
Age at first consensual sex (range 10–17 years)	14.78	1.48
Perceived risk of HIV (range 1.00–4.50)	2.28	.89
N		%
Ever used alcohol before sex ($n = 218$)	25	11.5
Ever used marijuana before sex ($n = 98$)	32	32.7
Ever used other drugs before sex ($n = 39$)	9	23.1
Median		IQR
Lifetime sex partners ($n = 219$; range 0–50)	2.00	4.00
Lifetime AMAB anal sex partners ($n = 219$, range 0–45)	1.00	2.00
AMAB partners, unprotected receptive anal sex ($n = 165$, range 0–44)	1.00	2.00
AMAB partners, unprotected insertive anal sex ($n = 165$, range 0–15)	1.00	1.00
Past-year alcohol consumption score ($n = 216$, range 0–8)	1.00	2.00

AMAB = assigned male at birth.

¹Differing Ns in individual sections due to survey branching logic and/or participants' selecting "I do not want to answer."

other-app users) reported ever having in-person meetings with a person they met from an app. In the past year, participants reported meeting a median of two people from the apps offline (IQR = 3, range 0–40). GBQ-app users reported having met more partners offline in the past year than other-app users (GBQ-app users median = 3, other-app users median = 1; Mann–Whitney $U = 527.0$, $z = -3.309$, $p = .001$). However, as GBQ-app users and other-app users were not significantly different in their likelihood of having ever met someone offline ($p = .36$), they will be described together in the remaining paragraphs.

Compared to participants who had not met anyone from the apps in person ($M = 16.29$, $SD = .81$), those who met partners through apps were somewhat older ($M = 16.50$, $SD = .65$), $F(1,183) = 3.997$, $p = .047$. They also had more lifetime partners AMAB (median = 3 vs. median = 2), Mann–Whitney $U = 2456.5$, $z = -4.805$, $p < .001$; and perceived themselves to be at greater risk of HIV ($M = 2.55$, $SD = .87$ vs. $M = 2.07$, $SD = .85$), $F(1,183) = 13.841$, $p < .001$. The two groups did not differ on any other demographic, sexual risk, or substance and alcohol use variables.

Over half of GBQ-app and other-app users (51.6%; $n = 96$) reported having met at least one sexual partner from the apps. In other words, 88.1% of the 109 participants who reported having an in-person meeting with someone from the apps subsequently had sexual contact with those individuals. Of these 96 participants, 47 described characteristics of only one partner, 29 described two partners, and 20 described their previous three app-met partners.

Characteristics of App-Met Partners and Partnerships

Participants reported on 166 partners met from applications (89.2% from GBQ apps; 10.8% from other apps); partner characteristics are described in Table 2. Nearly all partners were reported to be cisgender men (98.2%). Most partners

were reportedly older than the participant (61.4%); one-third were reportedly the same age as the participant (32.5%). The most commonly reported partner race/ethnicity was non-Hispanic White (62.0%) followed by Hispanic or Latino (19.9%) and Black (7.2%). Of those who reported both their own race/ethnicity and their partners' ($n = 163$), 48.5% of app-met partnerships reported were ones in which the participant and app-met partner were of different races/ethnicities.

Most partnerships were primarily one-time (38.0%) or recurrent (28.3%) casual sexual encounters; however, 12.7% reported that their primary relationship with an app-met partner was serious, and another 12.7% reported an app-met partner was primarily a friend. When asked to indicate what, if any, secondary types of relationships they had with their app-met partners, participants reported a variety of other relationships (friend 29.5%; recurrent casual sex partner 21.1%; one-time sex partner 20.5%; casually dating 9.0%; serious partner 7.8%).

Most partners were reportedly HIV-negative (68.1%) or of unknown status (30.1%). Participants reported that HIV-negative status was based on partner disclosure (87.6%) or assumption of partner status (8.0%). Participants who marked "other" ($n = 3$) indicated having learned of their partner's HIV status through testing together ($n = 1$) or from their app profile ($n = 2$). Participants disclosed that they were on PrEP for 3.0% of partnerships (three separate participants, one of whom reported three app-met partners); 10.6% of app-met partners were believed to be on PrEP.

Sexual Encounters with App-Met Partners

Participants reported engaging in a variety of sexual activities with the 166 app-met partners: 92.2% ($n = 153$) oral sex, 75.3% ($n = 125$) hand jobs, 65.1% ($n = 108$) anal sex; 3.0% ($n = 5$) reported threesomes or group sex, and 3.6% ($n = 6$) reported other types of sexual activity (e.g., kink). Of the 108 app-met partners with whom participants had anal sex, participants had insertive anal sex with over half (53.7%, $n = 58$); of those partnerships, participants reported CIAS in 51.7% ($n = 30$). Of the 108 app-met anal sex partners, 77.8% were receptive sex partners ($n = 84$) and of those, CRAS was reported with 52.4% ($n = 44$).

Chi-square analyses examined whether there were significant differences in ever having had CIAS and CRAS with app-met partners by partner characteristics (age, racial/ethnic concordance, relationship seriousness). The only significant difference to emerge was that a larger proportion of participants endorsed having CRAS with older partners (74.4%) than with partners who were similar in age or younger (25.6%), $\chi^2(1, N = 83) = 5.281, p = .025$.

Discussion

Prior research has shown that a majority of SGM AMAB use sexual networking applications intended for sexual minority male adults (Macapagal et al., 2018). Little else is known about minor adolescents' use of these technologies despite their critical implications for sexual health and wellbeing. Our study sought to add to this nascent literature by (1) assessing app use patterns and potential differences in app use by SGM AMAB's sociodemographics and sexual risk, and (2)

examining partner-seeking behaviors on GBQ and other types of apps, app-met partner characteristics, and sexual behavior with app-met partners. This study is the first to characterize app-met partnerships in a sample comprised exclusively of SGM AMAB who are minor adolescents (i.e., <18 years) and is one of the two empirical studies (Macapagal et al., 2018) to provide insight into their participation in a virtual sexual venue that is intended for legal adult members.

Although most GSN applications require users to be at least 18 years old, participants reported initiating app use in middle adolescence (ages 14–16), when exploring sex and sexual orientation is a normative developmental step (Fortenberry, 2013; Tulloch & Kaufman, 2013). At least one other study of sexual minority male adults reported that some initiated GBQ app use during this stage (Goedel & Duncan, 2015). Over 70% of SGM AMAB reported ever having used GBQ apps, which is substantially higher than in a previous study conducted in 2016–2017 in which 52.5% reported ever having used GBQ apps (Macapagal et al., 2018). Compared to this previous sample, the percentage of participants who reported having used only other types of apps decreased (30.5% in the previous study; 14.6% here), while the percentage of participants who used neither was similar (16.0% previously; 15.1% here). It is possible that sexual networking application use – or willingness of minors to disclose their use – has increased among SGM AMAB in a relatively short time. A true estimate of underage users may be difficult for researchers to confirm through app metrics or profile data, as users must indicate they are over age 18 to use the app, and for dating and GBQ-specific apps cannot select an age below 18.

Methodological differences also may have resulted in this perceived increase in use of GBQ apps between studies. For example, the prior study required participants to have reported anal sex with a male partner, whereas participants who had any sexual activity with a partner of any gender were eligible for this study, which may have captured more individuals who were using apps out of curiosity or for identity exploration. In addition, this study used a two-step method of assessing GBQ-app and other-app use, whereas the prior study derived app use groups from a "check all that apply" item, which may have been less sensitive. Nevertheless, these findings are further evidence that exploration of GBQ apps may be a normative part of sexuality development in this generation of SGM AMAB adolescents. That said, although online sexual behaviors may be more common in SGM adolescents (Ybarra & Mitchell, 2016), using the internet to facilitate dating and sex may also be increasing among adolescents in general. One study of ostensibly heterosexual minor adolescents found that use of apps for adults was not uncommon; for example, nearly 20% reported use of dating apps like Tinder (Lykens et al., 2019).

The majority of GBQ- and other-app users reported having in-person meetings with app-met individuals, most of whom ended up becoming the participants' sexual partners. Unsurprisingly, participants reported that these were predominantly one-time sexual encounters or recurring hookups, yet many reported having other types of relationships with app-met partners, including friendships or serious relationships. Among adult GBQ-app users, it is routine for such apps to facilitate the development of

Table 2. App-met partner and partnership characteristics ($N = 166$).¹

	N	%
Number of app-met partners reported in H-RASP measure		
1 (most recent partnership)	96	57.8
2 (second most recent partnership)	50	30.1
3 (third most recent partnership)	20	12.0
Number of app-met partners reported by app-user type		
GBQ-apps	148	89.2
Other apps	18	10.8
Gender of app-met partners		
Cisgender male	163	98.2
Transgender or nonbinary assigned male at birth	1	0.6
I do not want to answer	2	1.2
Age of app-met partners		
Older than me	102	61.4
About the same age	54	32.5
Younger than me	7	4.2
I do not know	1	0.6
I do not want to answer	2	1.2
Race/ethnicity of app-met partners		
Non-Hispanic White	103	62.0
Hispanic/Latino	33	19.9
Black	12	7.2
Asian or Pacific Islander	6	3.6
Multi-racial	6	3.6
Other	3	1.8
I do not want to answer	3	1.8
Race/ethnicity concordance with app-met partners ($n = 163$)		
Same race/ethnicity	84	51.5
Different race/ethnicity	79	48.5
What was your primary relationship with this partner?		
Serious relationship (like a boyfriend)	21	12.7
Casually dating	11	6.6
Fuck buddy or booty call	47	28.3
One night stand	63	38.0
Friend	21	12.7
I do not want to answer	3	1.8
What other kinds of relationships have you had with this person? (check all that apply)		
Serious relationship (like a boyfriend)	13	7.8
Casually dating	15	9.0
Fuck buddy or booty call	35	21.1
One night stand	34	20.5
Friend	49	29.5
I did not have any other type of relationship with this person	55	33.1
I do not want to answer	4	2.4
What types of (consensual) sexual contact have you had with this partner? (check all that apply)		
Hand job	125	75.3
Oral sex	153	92.2
Anal sex	108	65.1
Threesome/group sex	5	3.0
Other type of sexual contact	6	3.6
I do not want to answer	2	1.2
Partner HIV status		
Negative	113	68.1
Positive	0	0.0
I do not know	50	30.1
I do not want to answer	3	1.8
How did you learn about [partnername's] HIV status ($n = 113$)		
They told me	99	87.6
I found out through another person	1	0.9
I assumed their status	9	8.0
Other	3	2.7
I do not want to answer	1	0.9
While you were having sex with [partnername], were they taking PrEP to reduce their risk of HIV? ($n = 113$)		
Yes	12	10.6
No	68	60.2
I do not know	33	29.2
While you were having sex with [partnername], were you taking PrEP to reduce your risk of HIV?		

(Continued)

Table 2. (Continued).

	Median	IQR
Yes	5	3.0
No	159	95.8
I do not want to answer	2	1.2
Anal sex with app-met partners		
Insertive anal sex acts ($n = 58$; range 1–100 times)	1	1
Condomless insertive anal sex acts ($n = 30$; range 1–97 times)	1.5	2
Receptive anal sex acts ($n = 84$; range 1–100 times)	1	2
Condomless receptive anal sex acts ($n = 44$; range 0–100 times)	1	1.75

¹N refers to number of app-met partnerships reported in H-RASP measure that assessed characteristics of up to three of participants' most recent app-met partnerships. Differing Ns in individual variables due to survey branching logic. "I do not want to answer" responses came from three separate participants who declined to respond to certain items about four different partners.

other types of relationships, such as sexual relationships that later evolve into friendships or serious partnerships (Gudelunas, 2012; Holloway et al., 2014; Macapagal et al., 2016). For SGM AMAB adolescents, however, who are less likely to be out about their sexual orientation identity and may lack access to other SGM peers and potential partners where they live, sexual networking applications have the potential to contribute to a sense of belonging and social support similar to other online spaces and social media (Craig & McInroy, 2014; Harper et al., 2016).

App use was associated with both risk perceptions and behaviors (e.g., greater perceived HIV risk, more lifetime partners) and protective behaviors (e.g., having been tested for HIV) in this group, consistent with prior research (Macapagal et al., 2018). That said, even though app use was associated with having been tested for HIV, testing among app users was quite low (30.8%) and across the entire sample only 22.8% of adolescents were tested, consistent with prior work on SGM AMAB (Phillips, Ybarra, Prescott, Parsons, & Mustanski, 2015; Sharma et al., 2017). HIV risk behavior was not uncommon, with CRAS and CIAS occurring with over half of app-met partnerships in which adolescents reported anal sex; these findings are similar to studies of GBQ app-using adults (e.g., Lorimer et al., 2016). In addition, most partners were reportedly older than the participants, and adolescents were more likely to report CRAS with older partners than with younger partners. This may place them at greater risk for HIV given the greater prevalence among adult sexual minority men, coupled with CRAS posing a higher transmission risk (Anema et al., 2013; Chamberlain, Mena, Geter, & Crosby, 2017; Patel et al., 2014) and absent PrEP use reported by the sample. Moreover, research into sexual positioning has shown age-related power dynamics (e.g., youth anxiety about sex) and structural factors (e.g., access to space/venues) may render adolescents less confident in their ability to advocate for protected sex with an older partner (Dangerfield et al., 2018; Dangerfield, Smith, Williams, Unger, & Bluthenthal, 2017; Johns, Pingel, Eisenberg, Santana, &

Bauermeister, 2012). While these findings do not denote victimization per se, they are realities that point to developmental differences between sexual minority adult men and adolescents.

Age differences aside, CAS engagement with app-met partners was not associated with relationship seriousness, which is in contrast to research among sexual minority adult men (Goodreau et al., 2012; Sullivan, Salazar, Buchbinder, & Sanchez, 2009); further research is needed to substantiate this finding. Most app-met partners were believed to be of unknown status or HIV-negative, which was largely based on partner report or participant assumption rather than a confirmed test. For adolescents engaging in behaviors with app-met partners that pose very low HIV transmission risks (e.g., oral sex; Patel et al., 2014), partner status may seem less important to confirm. Moreover, it is possible that adolescents assume these partners are trustworthy after vetting them online and then deciding to meet them in person, and that further confirmation of HIV status is unnecessary. Nevertheless, as behaviors that posed low risks for HIV yet higher risks for STIs (CDC, 2017) were commonly reported with app-met partners, the possible role that online-initiated partnerships may play in adolescent STI transmission should be explored.

Strengths and Limitations

This study contributes to the literature by confirming that sexual networking app use is common among many SGM AMAB adolescents, and by offering a first look into SGM AMAB's partnerships with individuals met via sexual networking applications. That said, there were several limitations to our study that should be considered. First, for minor adolescents, disclosure of sexual networking application use may be a relatively sensitive topic. Participants may have provided socially desirable responses and under- or misreported their app use behaviors and app-met partners. It is possible that more participants had app-met partnerships but did not disclose them due to concerns about the legality of their app use or sexual behavior, or because of survey fatigue. Although most participants who completed the study reported feeling neutral to very comfortable answering such questions, those who tended to be more comfortable may have been more likely to complete the survey in the first place. That said, comfort level was not significantly associated with the number of app-met partners participants reported.

Second, due to IRB concerns that listing the names of GBQ and other dating/sexual networking apps in our study materials presented an inappropriate learning opportunity for minor adolescents, any items asking participants to disclose the specific apps they had ever used were converted from checkbox to open-ended items, which also may have contributed to under- or misreporting. Similarly, we did not ask participants to disclose the precise ages of their app-met partners given concerns about mandated reporting, which limited our ability to examine associations with age discrepancies. Third, although our data suggest an association between having used GBQ- and other-apps and engagement in sexual risk behavior with app-met partners, using the measures in this study we cannot disentangle whether risk behavior with

a particular partner is linked with the venue in which that person was met (e.g., online, offline), individual risk propensities, or both.

Finally, we acknowledge that there may be sampling bias. Adolescents who participated in this study were recruited largely from social media advertisements that targeted individuals whose interests were presumed to align with the SGM community; those who are less visibly connected to the community online may have different experiences with apps, or not have experiences with apps at all. Moreover, most participants were recruited from Facebook, which is declining in popularity among adolescents (Pew Research Center, 2018). It is not known whether SGM adolescents recruited from other platforms (e.g., Snapchat) differ in their online sexual behavior patterns. As such, these data may not be indicative of the prevalence of GSN app use and meeting partners online among the overall population of SGM AMAB adolescents and among other SGM populations.

Implications, Future Directions, and Conclusion

The findings have several implications for education, practice, and research with SGM AMAB. For example, content in sex education and HIV prevention programs should be inclusive of SGM AMAB's needs. Specifically, they should acknowledge that SGM AMAB adolescents may be exploring sexualized online spaces intended for adult users (e.g., GBQ apps, pornography sites), affirm their motivations for doing so, address the potential risks associated with using such platforms, and discuss alternatives that may meet their social, developmental, and sexual needs. Similar actions can be taken by parents of SGM AMAB and healthcare providers working with this population.

As we have only begun to understand SGM AMAB's use of these technologies, however, more research is needed to better guide education and intervention efforts. First, qualitative research on SGM AMAB's experiences navigating these applications could shed light on how adolescents determine potential partners' trustworthiness online and manage their safety during offline interactions (Albury & Byron, 2016). This line of inquiry can identify opportunities for educators and providers to help SGM adolescents mitigate potential risks of online partner/peer seeking. Second, our cross-sectional design precludes causal inferences about HIV risk behavior and app use. Research among adults has suggested that online partnerships do not cause sexual risk behavior, but rather reflect the propensity to engage in risk behavior independently of GSN app use (Jenness et al., 2010; Liao et al., 2006). Understanding whether these same patterns manifest among SGM AMAB who meet partners online can help pinpoint whether sexual health interventions should be targeted at the venue, individual-level user, or both.

Third, as SGM AMAB are likely present in sexualized online venues for adults, it may be fruitful to leverage these spaces for minor adolescent recruitment into HIV prevention research and sexual health outreach in ways that are ethical and aligned with those platforms' terms of service. For instance, recruitment campaigns for sexual health research with adults aged 18 and up could funnel ineligible

minors into adolescent-specific research. Fourth, some participants identified as gender minorities, and most GSN apps aimed at the SGM community are designed with cis-gender adult men in mind. Understanding gender minority adolescents' experiences navigating applications that were not specifically designed to meet their needs can shed light on ways social technologies can be optimized to be more inclusive and foster sexual well-being among often marginalized youth. Finally, existing adolescent relationship and sexual development models (Diamond & Savin-Williams, 2005; Fortenberry, 2014; Harden, 2014; Savin-Williams & Cohen, 2015) could be expanded to more explicitly account for the central role of online spaces, including mobile technologies and social media, in SGM adolescents' lives.

Taken together, this research underscores the need to better understand the unique relationship and sexual contexts of SGM adolescents, their impact on sexual development and wellbeing, and their possible role in contributing to sexual health disparities in SGM populations. In particular, continued attention to how SGM adolescents adopt rapidly changing technologies that promise to make connections with the SGM community more accessible can inform how and where we target interventions to improve adolescent mental health, sexual health, and wellbeing.

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